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I. *QUERIES, concerning the Cause of Cohesion of the Parts of Matter, proposed in a Letter to Dr. Desaguliers, F. R. S. By Fr. Triewald, Director of Mechanicks in the Kingdom of Sweden.*

Stockholm, Novem. 20. 1728.

Reverend S I R,

HAVING lately received the *Transactions* of the *Royal Society*, published since I left *England*, in order to settle in my native Country, I find you have been pleased, in *Numb. 389*, to take Notice of my Experiments made concerning the Cohesion of two Balls of Lead; and as I don't know any Body has assigned the true Cause of this Phænomenon, I beg you'll be pleased to propose the following *Queries* to that illustrious Society of which you are a worthy Member.

Query I. Does not this strong Cohesion of two Balls of Lead prove the Doctrine of Attraction, worthy its great Author, your late President Sir *Isaac Newton*; and that there is a universal Attraction between the Parts of Matter in Nature, though some at such small Distances as to escape our Observations, since we cannot make their Parts touch one another close enough, so as to come within their Sphere of Activity? Which I presume to be the Reason why I never have been able to make Balls of any other Metals to cohere: Nor do I believe that the Parts of any other Metal can come to such a close Contact, except by Fusion, as the Particles of Lead may, by

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being so many Degrees softer than those of any other Metal.

Query II. I have often found the touching Surfaces of such Leaden Balls, as near as I could measure, much alike; yet the Force of Cohesion very different: Nay, I have found the touching Surfaces very small, yet sometimes 114 to 126 lb Weight has not been sufficient to separate them; when at other Times a far less Weight (though the Measure of touching Surfaces far exceeded those mentioned) was more than sufficient to cause their Separation. Does it not prove that the Cohesion is strongest according to the closeness of the Contact, but not as the touching Surfaces? For which Reason I always have found the Cohesion strongest, when I gave a little twist in joining them; since by this Means the Particles must come closer together, than by squeezing the Balls barely on one another, though it was done with a far greater Force than I could apply with my bare Hands. And since the Force, Twist, and touching Surfaces can never be alike and mensurable when joined by Hand, I think it will be very difficult, if not impossible to ascertain the Forces of this Cohesion, which is incredible, and far exceeds Magnetical Attractions.

That the Pressure of the Atmosphere contributes little, and next to nothing in this Cohesion, I have fully proved and experienced last Winter, before a great and noble Assembly at my Lectures held in this Place: The Cohesion of two Leaden Balls, which 126 lb could not separate, prov'd as strong in *Vacuo*, as in the open Air.

Query

Query III. Does not this Experiment fairly account for the Cohesion of the Parts of Matter; and that this firm Cohesion cannot be derived from any Glue or Cement, any imaginary Hooks and Funiculus, nor *de gravitate Ætheris*: but that the Particles of all solid and fluid Bodies do attract one another by a certain Force (whatever be the Cause of the same) which acts most intensely the nearer they touch one another.

I am confirmed in this Opinion by an Experiment I made this Summer at *Dannemora*, one of the most considerable Iron Mines, and where I have erected the first and largest Fire-Engine for drawing Water and Oar in this Kingdom; the Cylinder being two Lines more than thirty-six Inches in Diameter.

Our *Dahlkarlians* have, Time out of Mind, practised the said Experiment, when they have had Occasion to remove any unweildy Stones of the hardest Rocks, and so big as not to be moved entire by any Strength they could apply. They practise the following Means, not only to cleave and split them in as many Parts and Pieces as they please, but they obtain Stones with one or more smooth Sides, fit for Use in Buildings. Their Method is thus.

They take Tallow, Greese, Train Oil, or any other fat Substances, and draw Lines on such large Stones, according as they would have them split, and think proper; then they lay either Char-Coal or Wood at Top, and round the Sides of the Stone, so that it is all over covered, and then kindle the Fuel; which when burned out, they find the Stone divided according to the Lines they have drawn on the same,

with some of the before-mentioned fat Substances, which seldom or never fails.

May one not account for this odd *Phænomenon* thus? That as the Action of Heat and Fire expands the Parts of all hard and solid Bodies and Metals themselves, so when the Action of the Fire about the Stone has made the Particles of the same recede farther from one another, than when in their natural State, the oily Substances insinuate themselves more and more between the Particles of the Stone; by which Means, when the Stone cools again, and shrinks, they seem to prevent these Particles from coming as close, and within their Sphere of Activity, as the remainder Particles may, where no such foreign Matter has been applied; by which Means they also cannot attract one another so strongly as the rest, and must therefore remain separated.

Fat and oily Substances seem to be most fit for this same Purpose, since they are endued with a repelling Force.

I can't but admire, that notwithstanding so many *Phænomena* in Nature prove a Tendency and a strong mutual Attraction of the Parts of Matter, whatever be the Cause, yet most learned Men, of several Nations, would rather charge such manifest Qualities and Operations of Nature with the Nick-Name of occult Qualities, than give the Honour to the *great Discoverer (who is no more)* of those manifest Qualities and Principles of Motion. However, I am confident, that as Nature is very uniform and agreeable to herself, she'll evince the Truth of her Operations.

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If I find you pardon this Liberty I have taken by this, it will encourage me to transmit several Experiments and Observations I have lately made, remaining with the utmost Sincerity,

Most Reverend S I R,

Your most obedient humble Servant,

F. Triewald,

*Director of Mechanicks in the
Kingdom of Sweden.*

II. A Letter to Dr. Rutty, R. S. Secr. giving a farther Account of the Nature and Virtues of the Holt-Waters, from the Reverend Mr. J. Lewis, Vicar of the Place.

S I R,

IN a Letter I received lately from Mr. *Brome*, he gave me an Account that he had communicated to you a Paper of mine, relating to the Mineral Waters at *Holt*; and that you had sent it to the Press among the *Philosophical Memoirs* of the *Royal Society*; which I was pleased to hear, because I hoped it might be a Means to raise the Esteem of the Waters, and recommend them to the good Opinion of the learned World. He likewise informed me, that you was willing to enquire into some further Particulars relating to those Waters.

This Intimation of yours to Mr. *Brome* has drawn upon you the Trouble of this Paper; being willing
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